

ABSTRACT

Methods, systems, and apparatus consistent with the present invention apply one or more laser beams to a glass object, such as a tube. The beams may have differing wavelengths, energy levels, and/or focal length characteristics. As the beam (single or multiple) penetrates the glass tube, it creates a channel. The beam is provided through the channel to a starting point on a region of the glass tube, usually the region below an inside diameter surface of the tube. In one embodiment, the beam is used to selectively heat a reactant gas within the tube to deposit a coating/dopant layer on the inside diameter surface. In another embodiment, the coating layer is already present and the beam selectively heats the layer causing thermal diffusion of the coating material into the glass tube at the region being heated. Next, the laser beam is moved relative to the glass tube while the beam is selectively heating portions of the tube causing further thermal diffusion and creating a refractive gradient design within the tube with the laser energy.

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